

Amendments to the Claims:

Please cancel claims 1887 and 1926 without prejudice.

The following lists all claims and their status:

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1-1882 (cancelled)

1883. (currently amended): A method of treating a hydrocarbon containing formation in situ, comprising:

assessing an atomic hydrogen to carbon ratio of at least some hydrocarbons in the formation;

selecting a part of the formation for heating, wherein at least some hydrocarbons in the part have an atomic hydrogen to carbon ratio greater than about 0.70 and less than about 1.65;

providing heat from one or more heaters to at least a portion of the formation;

allowing the heat to transfer from the one or more heaters to ~~a~~ the part of the formation;

and

~~wherein the part of the formation has been selected for heating using an atomic hydrogen to carbon ratio of at least a portion of hydrocarbons in the part of the formation, wherein at least a portion of the hydrocarbons in the part of the formation comprises an atomic hydrogen to carbon ratio greater than about 0.70, and wherein the atomic hydrogen to carbon ratio is less than about 1.65; and~~

producing a mixture from the formation.

1884. (currently amended): The method of claim 1883, wherein the one or more heaters comprise at least two heaters, and wherein controlled superposition of heat from at least the two heaters pyrolyzes at least some hydrocarbons ~~within~~ in the part of the formation.

1885. (currently amended): The method of claim 1883, further comprising maintaining a temperature ~~within~~ in the part of the formation ~~within~~ in a pyrolysis temperature range.

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1886. (currently amended): The method of claim 1883, wherein at least one of the one or more
~~of the heaters comprise~~ comprises an electrical heater heater.

1887. (cancelled)

1888. (currently amended): The method of claim 1883, wherein at least one of the one or more
~~of the heaters comprise~~ comprises a flameless distributed combustor combustor.

1889. (currently amended): The method of claim 1883, wherein at least one of the one or more
~~of the heaters comprise~~ comprises a natural distributed combustor combustor.

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1890. (currently amended): The method of claim 1883, further comprising controlling a
pressure and a temperature ~~within~~ in at least a majority of the part of the formation, wherein the
pressure is controlled as a function of temperature, or the temperature is controlled as a function
of pressure.

1891. (currently amended): The method of claim 1883, further comprising ~~wherein allowing~~
~~the heat to transfer from the portion of the formation to a part of the formation~~ comprises
pyrolyzing hydrocarbons ~~within~~ in the part of the formation, and ~~further comprising~~ controlling
the heat such that an average heating rate of the part of the formation is less than about 1 °C per
day during pyrolysis.

1892. (currently amended): The method of claim 1883, wherein providing heat from the one or
more ~~of the heaters to at least the portion of~~ the formation comprises:

heating a selected volume (V) of the hydrocarbon containing formation from one or more
of the heaters, wherein the formation has an average heat capacity (C_v), and wherein the heating
pyrolyzes at least some hydrocarbons within the selected volume of the formation; and

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wherein heating energy/day (P_{wr}) provided to the selected volume is equal to or less than $h*V*C_v*\rho_B$, wherein ρ_B is formation bulk density, and wherein an average heating rate (h) of the selected volume is about 10 °C/day.

1893. (original): The method of claim 1883, wherein allowing the heat to transfer comprises transferring heat substantially by conduction.

1894. (currently amended): The method of claim 1883, wherein providing heat from one or more of the heaters comprises heating the part of the formation ~~such that to increase~~ a thermal conductivity of at least a portion of the part of the formation ~~is to~~ greater than about 0.5 W/(m °C).

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1895. (original): The method of claim 1883, wherein the produced mixture comprises condensable hydrocarbons having an API gravity of at least about 25°.

1896. (original): The method of claim 1883, wherein the produced mixture comprises condensable hydrocarbons, and wherein about 0.1 % by weight to about 15 % by weight of the condensable hydrocarbons are olefins.

1897. (original): The method of claim 1883, wherein the produced mixture comprises non-condensable hydrocarbons, and wherein a molar ratio of ethene to ethane in the non-condensable hydrocarbons ranges from about 0.001 to about 0.15.

1898. (original): The method of claim 1883, wherein the produced mixture comprises condensable hydrocarbons, and wherein less than about 1 % by weight, when calculated on an atomic basis, of the condensable hydrocarbons is nitrogen.

1899. (original): The method of claim 1883, wherein the produced mixture comprises condensable hydrocarbons, and wherein less than about 1 % by weight, when calculated on an atomic basis, of the condensable hydrocarbons is oxygen.

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1900. (original): The method of claim 1883, wherein the produced mixture comprises condensable hydrocarbons, and wherein less than about 1 % by weight, when calculated on an atomic basis, of the condensable hydrocarbons is sulfur.

1901. (original): The method of claim 1883, wherein the produced mixture comprises condensable hydrocarbons, wherein about 5 % by weight to about 30 % by weight of the condensable hydrocarbons comprise oxygen containing compounds, and wherein the oxygen containing compounds comprise phenols.

1902. (original): The method of claim 1883, wherein the produced mixture comprises condensable hydrocarbons, and wherein greater than about 20 % by weight of the condensable hydrocarbons are aromatic compounds.

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1903. (original): The method of claim 1883, wherein the produced mixture comprises condensable hydrocarbons, and wherein less than about 5 % by weight of the condensable hydrocarbons comprises multi-ring aromatics with more than two rings.

1904. (original): The method of claim 1883, wherein the produced mixture comprises condensable hydrocarbons, and wherein less than about 0.3 % by weight of the condensable hydrocarbons are asphaltenes.

1905. (original): The method of claim 1883, wherein the produced mixture comprises condensable hydrocarbons, and wherein about 5 % by weight to about 30 % by weight of the condensable hydrocarbons are cycloalkanes.

1906. (currently amended): The method of claim 1883, wherein the produced mixture comprises a non-condensable component that does not condense at 25 °C and one atmosphere absolute pressure, wherein the non-condensable component comprises molecular hydrogen, wherein the molecular hydrogen is greater than about 10 % by volume of the non-condensable

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component at 25 °C and one atmosphere absolute pressure, and wherein the molecular hydrogen is less than about 80 % by volume of the non-condensable component at 25 °C and one atmosphere absolute pressure.

1907. (original): The method of claim 1883, wherein the produced mixture comprises ammonia, and wherein greater than about 0.05 % by weight of the produced mixture is ammonia.

1908. (original): The method of claim 1883, wherein the produced mixture comprises ammonia, and wherein the ammonia is used to produce fertilizer.

1909. (currently amended): The method of claim 1883, further comprising controlling a pressure ~~within in~~ at least a majority of the part of the formation, wherein the controlled pressure is at least about 2.0 ~~bar~~ bars absolute.

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1910. (currently amended): The method of claim 1883, further comprising controlling formation conditions to produce the mixture, wherein a partial pressure of H₂ ~~within in~~ the mixture is greater than about 0.5 bar.

1911. (currently amended): The method of claim 1910, wherein the partial pressure of H₂ ~~within in~~ the mixture is measured when the mixture is at a production well.

1912. (currently amended): The method of claim 1883, further comprising altering a pressure ~~within in~~ the formation to inhibit production of hydrocarbons from the formation having carbon numbers greater than about 25.

1913. (original): The method of claim 1883, further comprising controlling formation conditions by recirculating a portion of hydrogen from the mixture into the formation.

1914. (currently amended): The method of claim 1883, further comprising:

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providing hydrogen (H₂) to the heated part of the formation to hydrogenate hydrocarbons within in the part of the formation; and
heating a portion of the part of the formation with heat from hydrogenation.

1915. (original): The method of claim 1883, further comprising:
producing hydrogen and condensable hydrocarbons from the formation; and
hydrogenating a portion of the produced condensable hydrocarbons with at least a portion of the produced hydrogen.

1916. (currently amended): The method of claim 1883, wherein allowing the heat to transfer comprises increasing-increases a permeability of a majority of the part of the formation to greater than about 100 millidarcy.

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1917. (currently amended): The method of claim 1883, wherein allowing the heat to transfer comprises substantially uniformly increasing-increases a permeability of a majority of the part of the formation such that the permeability of the majority of the part is substantially uniform.

1918. (original): The method of claim 1883, further comprising controlling the heat to yield greater than about 60 % by weight of condensable hydrocarbons, as measured by the Fischer Assay.

1919. (previously amended): The method of claim 1883, wherein producing the mixture comprises producing the mixture in a production well, and wherein at least about 7 heaters are disposed in the formation for each production well.

1920. (previously amended): The method of claim 1883, further comprising providing heat from three or more heaters to at least a portion of the formation, wherein three or more of the heaters are located in the formation in a unit of heaters, and wherein the unit of heaters comprises a triangular pattern.

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1921. (previously amended): The method of claim 1883, further comprising providing heat from three or more heaters to at least a portion of the formation, wherein three or more of the heaters are located in the formation in a unit of heaters, wherein the unit of heaters comprises a triangular pattern, and wherein a plurality of the units are repeated over an area of the formation to form a repetitive pattern of units.

1922. (currently amended): A method of treating a hydrocarbon containing formation in situ, comprising:

assessing an atomic hydrogen to carbon ratio of at least some hydrocarbons in the formation;

selecting a part of the formation for heating, wherein at least some hydrocarbons in the part have an initial atomic hydrogen to carbon ratio greater than about 0.70 and less than about 1.65;

providing heat from one or more heaters to ~~a~~ the part of the formation;

allowing the heat to transfer from the one or more heaters to the part of the formation to pyrolyze hydrocarbons ~~within in~~ the part of the formation; and

~~wherein at least some hydrocarbons within the part of the formation have an initial atomic hydrogen to carbon ratio greater than about 0.70;~~

~~wherein the initial atomic hydrogen to carbon ration is less than about 1.65; and~~

producing a mixture from the formation.

1923. (currently amended): The method of claim 1922, wherein the one or more heaters comprise at least two heaters, and wherein controlled superposition of heat from at least the two heaters pyrolyzes at least some hydrocarbons ~~within in~~ the part of the formation.

1924. (currently amended): The method of claim 1922, further comprising maintaining a temperature ~~within in~~ the part of the formation ~~within in~~ a pyrolysis temperature range.

1925. (currently amended): The method of claim 1922, wherein at least one of the one or more ~~of the heaters comprise~~ comprises an electrical heatersheater.

1926. (cancelled)

1927. (currently amended): The method of claim 1922, wherein at least one of the one or more
~~of the heaters comprise~~ comprises a flameless distributed combustor.

1928. (currently amended): The method of claim 1922, wherein at least one of the one or more
~~of the heaters comprise~~ comprises a natural distributed combustor.

1929. (currently amended): The method of claim 1922, further comprising controlling a
pressure and a temperature ~~within~~ in at least a majority of the part of the formation, wherein the
pressure is controlled as a function of temperature, or the temperature is controlled as a function
of pressure.

1930. (previously amended): The method of claim 1922, further comprising controlling the
heat such that an average heating rate of the part of the formation is less than about 1 °C per day
during pyrolysis.

1931. (currently amended): The method of claim 1922, wherein providing heat from the one or
~~more of the heaters~~ to at least the portion of the formation comprises:

heating a selected volume (V) of the hydrocarbon containing formation from one or more
of the heaters, wherein the formation has an average heat capacity (C_v), and wherein the heating
pyrolyzes at least some hydrocarbons ~~within~~ in the selected volume of the formation; and

wherein heating energy/day (P_{wr}) provided to the selected volume is equal to or less than
 $h * V * C_v * \rho_B$, wherein ρ_B is formation bulk density, and wherein an average heating rate (h) of the
selected volume is about 10 °C/day.

1932. (original): The method of claim 1922, wherein allowing the heat to transfer comprises
transferring heat substantially by conduction.

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1933. (currently amended): The method of claim 1922, wherein providing heat from one or more of the heaters comprises heating the part of the formation ~~such that~~ to increase a thermal conductivity of at least a portion of the part of the formation ~~is to~~ greater than about 0.5 W/(m °C).

1934. (original): The method of claim 1922, wherein the produced mixture comprises condensable hydrocarbons having an API gravity of at least about 25°.

1935. (original): The method of claim 1922, wherein the produced mixture comprises condensable hydrocarbons, and wherein about 0.1 % by weight to about 15 % by weight of the condensable hydrocarbons are olefins.

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1936. (original): The method of claim 1922, wherein the produced mixture comprises non-condensable hydrocarbons, and wherein a molar ratio of ethene to ethane in the non-condensable hydrocarbons ranges from about 0.001 to about 0.15.

1937. (original): The method of claim 1922, wherein the produced mixture comprises condensable hydrocarbons, and wherein less than about 1 % by weight, when calculated on an atomic basis, of the condensable hydrocarbons is nitrogen.

1938. (original): The method of claim 1922, wherein the produced mixture comprises condensable hydrocarbons, and wherein less than about 1 % by weight, when calculated on an atomic basis, of the condensable hydrocarbons is oxygen.

1939. (original): The method of claim 1922, wherein the produced mixture comprises condensable hydrocarbons, and wherein less than about 1 % by weight, when calculated on an atomic basis, of the condensable hydrocarbons is sulfur.

1940. (original): The method of claim 1922, wherein the produced mixture comprises condensable hydrocarbons, wherein about 5 % by weight to about 30 % by weight of the

condensable hydrocarbons comprise oxygen containing compounds, and wherein the oxygen containing compounds comprise phenols.

1941. (original): The method of claim 1922, wherein the produced mixture comprises condensable hydrocarbons, and wherein greater than about 20 % by weight of the condensable hydrocarbons are aromatic compounds.

1942. (original): The method of claim 1922, wherein the produced mixture comprises condensable hydrocarbons, and wherein less than about 5 % by weight of the condensable hydrocarbons comprises multi-ring aromatics with more than two rings.

1943. (original): The method of claim 1922, wherein the produced mixture comprises condensable hydrocarbons, and wherein less than about 0.3 % by weight of the condensable hydrocarbons are asphaltenes.

1944. (original): The method of claim 1922, wherein the produced mixture comprises condensable hydrocarbons, and wherein about 5 % by weight to about 30 % by weight of the condensable hydrocarbons are cycloalkanes.

1945. (currently amended): The method of claim 1922, wherein the produced mixture comprises a non-condensable component that does not condense at 25 °C and one atmosphere absolute pressure, wherein the non-condensable component comprises molecular hydrogen, wherein the molecular hydrogen is greater than about 10 % by volume of the non-condensable component at 25 °C and one atmosphere absolute pressure, and wherein the molecular hydrogen is less than about 80 % by volume of the non-condensable component at 25 °C and one atmosphere absolute pressure.

1946. (original): The method of claim 1922, wherein the produced mixture comprises ammonia, and wherein greater than about 0.05 % by weight of the produced mixture is ammonia.

1947. (original): The method of claim 1922, wherein the produced mixture comprises ammonia, and wherein the ammonia is used to produce fertilizer.

1948. (currently amended): The method of claim 1922, further comprising controlling a pressure ~~within-in~~ at least a majority of the part of the formation, wherein the controlled pressure is at least about 2.0 ~~bar-bars~~ absolute.

1949. (currently amended): The method of claim 1922, further comprising controlling formation conditions to produce the mixture, wherein a partial pressure of H₂ ~~within-in~~ the mixture is greater than about 0.5 bar.

1950. (currently amended): The method of claim 1949, wherein the partial pressure of H₂ ~~within-in~~ the mixture is measured when the mixture is at a production well.

1951. (currently amended): The method of claim 1922, further comprising altering a pressure ~~within-in~~ the formation to inhibit production of hydrocarbons from the formation having carbon numbers greater than about 25.

1952. (original): The method of claim 1922, further comprising controlling formation conditions by recirculating a portion of hydrogen from the mixture into the formation.

1953. (currently amended): The method of claim 1922, further comprising:
providing hydrogen (H₂) to the heated ~~section-part~~ to hydrogenate hydrocarbons ~~within-in~~ the part of the formation; and
heating a portion of the part of the formation with heat from hydrogenation.

1954. (original): The method of claim 1922, further comprising:
producing hydrogen and condensable hydrocarbons from the formation; and
hydrogenating a portion of the produced condensable hydrocarbons with at least a portion of the produced hydrogen.

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1955. (currently amended): The method of claim 1922, wherein allowing the heat to transfer ~~comprises increasing~~ increases a permeability of a majority of the part of the formation to greater than about 100 millidarcy.

1956. (currently amended): The method of claim 1922, wherein allowing the heat to transfer ~~comprises substantially uniformly increasing~~ increases a permeability of a majority of the part of the formation such that the permeability of the majority of the part is substantially uniform.

1957. (original): The method of claim 1922, further comprising controlling the heat to yield greater than about 60 % by weight of condensable hydrocarbons, as measured by the Fischer Assay.

1958. (previously amended): The method of claim 1922, wherein producing the mixture comprises producing the mixture in a production well, and wherein at least about 7 heaters are disposed in the formation for each production well.

1959. (previously amended): The method of claim 1922, further comprising providing heat from three or more heaters to at least a portion of the formation, wherein three or more of the heaters are located in the formation in a unit of heaters, and wherein the unit of heaters comprises a triangular pattern.

1960. (previously amended): The method of claim 1922, further comprising providing heat from three or more heaters to at least a portion of the formation, wherein three or more of the heaters are located in the formation in a unit of heaters, wherein the unit of heaters comprises a triangular pattern, and wherein a plurality of the units are repeated over an area of the formation to form a repetitive pattern of units.

1961 – 5395 (cancelled)

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5396. (previously amended): The method of claim 1919, wherein at least about 20 heaters are disposed in the formation for each production well.

5397. (previously amended): The method of claim 1958, wherein at least about 20 heaters are disposed in the formation for each production well.

5398. (previously added): The method of claim 1883, wherein the part of the formation comprises a selected section.

5399. (previously added): The method of claim 1883, wherein the part of the formation comprises a pyrolysis zone.

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5400. (previously added): The method of claim 1883, wherein the part of the formation comprises a pyrolysis zone proximate to and/or surrounding at least one of the heaters.

5401. (previously added): The method of claim 1883, wherein at least one of the heaters is disposed in an open wellbore.

5402. (previously added): The method of claim 1922, wherein the part of the formation comprises a selected section.

5403. (previously added): The method of claim 1922, wherein the part of the formation comprises a pyrolysis zone.

5404. (previously added): The method of claim 1922, wherein the part of the formation comprises a pyrolysis zone proximate to and/or surrounding at least one of the heaters.

5405. (previously added): The method of claim 1922, wherein at least one of the heaters is disposed in an open wellbore.

5406. (currently amended): A method of treating a hydrocarbon containing formation in situ, comprising:

assessing an atomic hydrogen to carbon ratio of at least some hydrocarbons in the formation;

selecting a part of the formation for heating, wherein at least some hydrocarbons in the part have an initial atomic hydrogen to carbon ratio greater than about 0.70 and less than about 1.65;

providing heat from one or more heat sources to ~~a~~ the part of the formation, wherein the heated part of the formation is proximate the heat sources;

allowing the heat to transfer from the one or more heat sources in the part to a pyrolysis zone to pyrolyze hydrocarbons ~~within~~ in the pyrolysis zone; and

~~wherein at least some hydrocarbons within the pyrolysis zone have an initial atomic hydrogen to carbon ratio greater than about 0.70;~~

~~wherein the initial atomic hydrogen to carbon ratio is less than about 1.65; and~~

producing a mixture from the formation.

5407. (currently amended): The method of claim 5406, wherein the one or more ~~of the~~ heat sources comprise at least two heat sources, and wherein superposition of heat from at least the two heat sources pyrolyzes at least some hydrocarbons ~~within~~ in the pyrolysis zone.

5408. (currently amended): The method of claim 5406, further comprising maintaining a temperature ~~within~~ in the pyrolysis zone ~~within~~ in a pyrolysis temperature range, wherein the pyrolysis temperature range is from about 250 °C to about 370 °C.

5409. (currently amended): The method of claim 5406, further comprising controlling a pressure and a temperature ~~within~~ in at least a majority of the pyrolysis zone, wherein the pressure is controlled as a function of temperature, or the temperature is controlled as a function of pressure.

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5410. (previously added): The method of claim 5406, further comprising producing a mixture from the formation, wherein the produced mixture comprises condensable hydrocarbons having an API gravity of at least about 25°.

5411. (previously added): The method of claim 5406, wherein the pyrolysis zone comprises a selected section.

5412. (currently amended): The method of claim 5406, wherein at least one of the heat sources ~~comprise~~ comprises a natural distributed ~~combustor~~ combustor.

5413. (previously added): The method of claim 5406, wherein at least one of the heat sources is disposed in an open wellbore.

5414. (currently amended): The method of claim 5406, wherein allowing the heat to transfer ~~comprises substantially uniformly increasing~~ increases a permeability of a majority of the pyrolysis zone such that the permeability of the majority of the part is substantially uniform.

5415. (currently amended): The method of claim 5406, wherein providing heat from the one or more ~~of the~~ heat sources to at least the portion of the formation comprises:

heating a selected volume (V) of the coal formation from one or more of the heat sources, wherein the formation has an average heat capacity (C_v), and wherein the heating pyrolyzes at least some hydrocarbons ~~within in~~ in the selected volume of the formation; and

wherein heating energy/day (Pwr) provided to the selected volume is equal to or less than $h * V * C_v * \rho_B$, wherein ρ_B is formation bulk density, and wherein an average heating rate (h) of the selected volume is about 10 °C/day.